

REMARKS/ARGUMENTS

In response to the Office Action mailed January 3, 2006 finally rejecting examined claims 19 and 20, Applicants request reconsideration.

Claims 1-4, 6-8, 10-16, 19, and 10 are pending in this patent application. Claims 1-4 are withdrawn from consideration. Claims 6-8 and 10-16 are allowed.

Claims 19 and 20 have been finally rejected as obvious over Yamaguchi (Published U.S. Patent Application 2005/0167768) in view of Yamazaki et al. (Published U.S. Patent Application 2005/0110091, hereinafter Yamazaki). This rejection is again respectfully traversed for entirely independent reasons.

Assuming Yamaguchi is prior art, Applicants rely upon the argument presented in the Amendment filed November 30, 2005 as distinguishing claims 19 and 20 from the proposed combination of Yamaguchi and Yamazaki. The argument is incorporated by reference without again being set out at length.

This Request for Reconsideration is filed to emphasize the point not commented upon by the Examiner with regard to claims 19 and 20, namely that Yamaguchi is not prior art under U.S. law and therefore the rejection is legally defective and cannot be properly maintained.

The present patent application was filed in the United States on March 30, 2004. Although a foreign priority of December 26, 2003 was claimed, the priority date of the present patent application has not been perfected. Thus, at the present time, Applicants rely upon March 30, 2004 as the effective date of their patent application.

Yamaguchi is a published U.S. patent application that was published on August 4, 2005. The underlying U.S. patent application of Yamaguchi was filed on March 25, 2005, almost one year after the effective date of the present patent application. Therefore, Yamaguchi cannot be prior art to the present patent application unless the effective filing date of Yamaguchi is the filing date of the international application, filed in Japan on March 17, 2003, from which Yamaguchi claimed priority pursuant to 35 USC 356(c), i.e., as a continuation application, not as a national phase application under 35 USC 371.

Attached to this Response is a copy of the title page and the first page of the description of Published International Application WO2004/084291, the published form

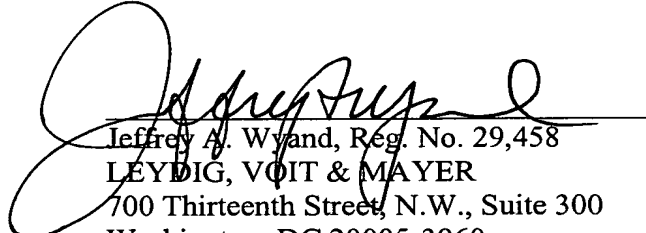
of the international application from which Yamaguchi claims priority. These two attached pages demonstrate that the international application of Yamaguchi (incorrectly referring to the inventor as Yaguchi) was published in Japanese, not in English. Comparison of the application number for that international publication with the application number appearing on the front page of the Yamaguchi U.S. publication confirms the relationship of the published international application to the published U.S. patent application.

In order to determine the effective date, for prior art purposes, of Yamaguchi, the Examiner's attention is directed to example 8 appearing at pages 700-37 and 700-38 of the MPEP. A copy is attached. This example exactly matches the present situation and conclusively demonstrates that the effective date, for prior art purposes, "is the actual U.S. filing date of the 35 U.S.C. 111(a) application. No benefit of the international filing date (nor any U.S. filing dates prior to the I[nternation] A[pplication]) is given for 35 U.S.C. 102(e) purposes since the IA is published under PCT Article 21(2) in a language other than English."

Yamaguchi is conclusively not prior art to the present patent application pursuant to any sub-section of 35 USC 102, as interpreted by the U.S. Patent and Trademark Office and pursuant to the instructions given to examiners in MPEP 706.02(f)(1). Therefore, the rejection of claims 19 and 20 must be withdrawn and the Examiner has no discretion to make or maintain any rejection in this patent application based upon Yamaguchi.

Upon an indication of allowability of claims 19 and 20, claims 1-4 will be cancelled, subject to the right to file a divisional patent application.

Respectfully submitted,



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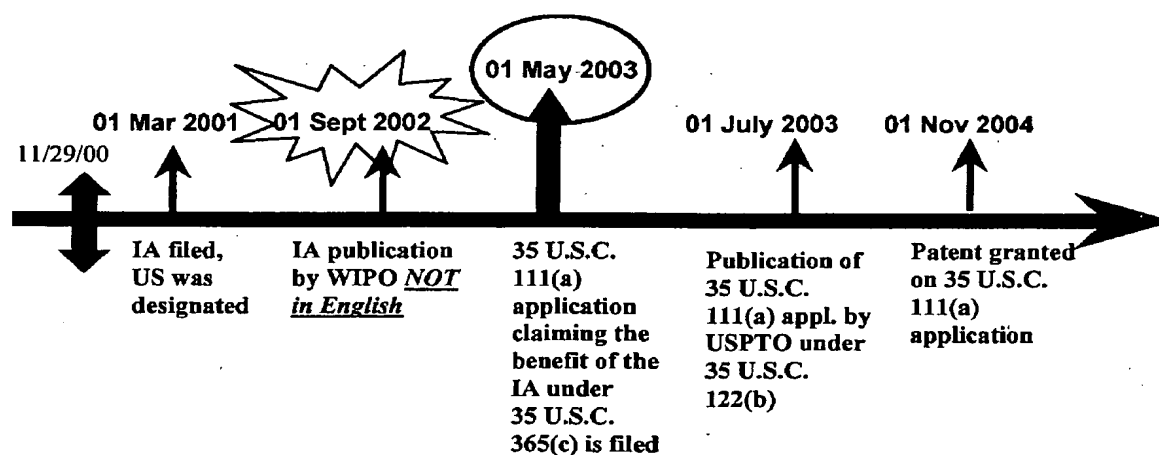
Additional Priority/Benefit Claims:

If the IA properly claimed priority to an earlier-filed U.S. provisional (35 U.S.C. 111(b)) application or the benefit of an earlier-filed U.S. nonprovisional (35 U.S.C. 111(a)) application, the 35 U.S.C. 102(e) date for all the references would be the filing date of the earlier-filed U.S. application, assuming the earlier-filed application has proper support for the subject matter relied upon as required by 35 U.S.C. 119(e) or 120.

If a second, later-filed U.S. nonprovisional (35 U.S.C. 111(a)) application claimed the benefit of the 35 U.S.C. 111(a) application in the example above, the 35 U.S.C. 102(e) date of the patent or publication of the second, later-filed U.S. application would still be the international filing date of the IA, assuming the earlier-filed IA has proper support for the subject matter relied upon as required by 35 U.S.C. 120 and 365(c).

Example 8: References based on a 35 U.S.C. 111(a) Application which is a **Continuation of an International Application**, which was filed on or after November 29, 2000 and was **not published in English** under PCT Article 21(2).

Both the U.S. publication and the U.S. patent of the 35 U.S.C. 111(a) continuation of an international application (IA) that was filed on or after November 29, 2000 but **not** published in English under PCT Article 21(2) have the 35 U.S.C. 102(e) prior art date of the actual U.S. filing date of the 35 U.S.C. 111(a) application. No benefit of the international filing date (nor any U.S. filing dates prior to the IA) is given for 35 U.S.C. 102(e) purposes since the IA was published under PCT Article 21(2) in a language other than English. The IA publication under PCT Article 21(2) does not have a prior art date under 35 U.S.C. 102(e)(1) because the IA was not published in English under PCT Article 21(2). The IA publication under PCT Article 21(2) can be applied under 35 U.S.C. 102(a) or (b) as of its publication date.



The 35 U.S.C. 102(e)(1) date for the IA Publication by WIPO is: None.
The 35 U.S.C. 102(e)(1) date for the Publication by USPTO is: 01 May 2003.
The 35 U.S.C. 102(e)(2) date for the Patent is: 01 May 2003

The IA publication by WIPO can be applied under 35 U.S.C. 102(a) or (b) as of its publication date (01 Sept 2002).

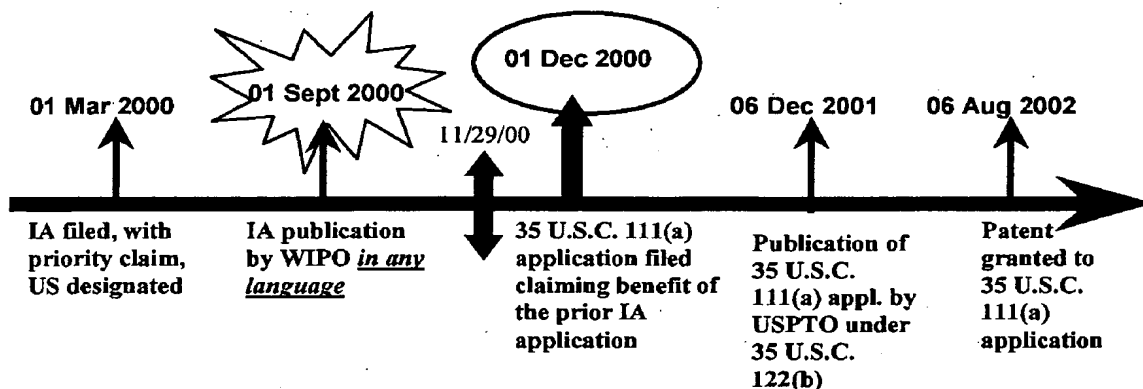
Additional Priority/Benefit Claims:

If the IA properly claimed priority/benefit to any earlier-filed U.S. application (whether provisional or nonprovisional), there would still be no 35 U.S.C. 102(e)(1) date for the IA publication by WIPO, and the U.S. patent application publication and patent would still have a 35 U.S.C. 102(e) date of the actual filing date of the later-filed 35 U.S.C. 111(a) application in the example above (01 May 2003).

If a second, later-filed U.S. nonprovisional (35 U.S.C. 111(a)) application claimed the benefit of the 35 U.S.C. 111(a) application in the example above, the 35 U.S.C. 102(e) date of the patent or publication of the second, later-filed U.S. application would still be the actual filing date of the 35 U.S.C. 111(a) application in the example above (01 May 2003).

Example 9: References based on a 35 U.S.C. 111(a) Application which is a **Continuation** (filed prior to any entry of the national stage) of an **International Application**, which was filed prior to November 29, 2000 (language of the publication under PCT Article 21(2) is not relevant).

Both the U.S. publication and the U.S. patent of the 35 U.S.C. 111(a) continuation (filed prior to any entry of the national stage) of an international application (IA) that was filed prior to November 29, 2000 have the 35 U.S.C. 102(e) prior art date of their actual U.S. filing date under 35 U.S.C. 111(a). No benefit of the international filing date (nor any U.S. filing dates prior to the IA) is given for 35 U.S.C. 102(e) prior art purposes since the IA was filed prior to November 29, 2000. The IA publication under PCT Article 21(2) does not have a prior art date under 35 U.S.C. 102(e)(1) because the IA was filed prior to November 29, 2000. The IA publication under PCT Article 21(2) can be applied under 35 U.S.C. 102(a) or (b) as of its publication date.



The 35 U.S.C. 102(e)(1) date for the IA Publication by WIPO is: None.
 The 35 U.S.C. 102(e)(1) date for the Publication by USPTO is: 01 Dec. 2000.
 The 35 U.S.C. 102(e)(2) date for the Patent is: 01 Dec. 2000.

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(81) 指定国 (国内): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

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/続葉有/

(54) Title: SEMICONDUCTOR DEVICE AND METHOD FOR MANUFACTURING SEMICONDUCTOR DEVICE

(54) 発明の名称: 半導体装置と半導体装置の製造方法

		R (300 sccm)		
		TTBAI	TEAI	TDMAHf
1	R+O ₂ (100 sccm) + N ₂ (700 sccm)	×	×	×
2	R+NH ₃ (300 sccm) + N ₂ (500 sccm)	○	△	×
3	R+NH ₃ (300 sccm) + H ₂ (300 sccm) + N ₂ (200 sccm)	◎	○	○
4	R+O ₂ +N ₂ /NH ₃ +N ₂ (1100 sccm)	○	○	△
5	R+O ₂ +H ₂ +N ₂ /NH ₃ +H ₂ +N ₂ (1100 sccm)	◎	◎	◎
		TTBAI+TDMAHf		
		◎		

× : N not detected

△ : N detected

○ : N mixed

◎ : N more mixed

(57) Abstract: A method for manufacturing a semiconductor device in which a film of an oxide of $\text{Hf}_{1-x}\text{Al}_x$ ($0 < x < 0.3$) having desired properties is formed as a gate insulating film. The method comprises a step (a) of heating a silicon substrate in a reaction chamber and a step (b) of depositing an $\text{Hf}_{1-x}\text{Al}_x\text{O}_2\text{N}$ film ($0.1 < x < 0.3$) having a dielectric constant higher than that of silicon oxide and containing absorbed N on the heated silicon substrate by thermal CVD while supplying a film-forming gas containing a material gas, a nitrogen gas, and a nitriding-promoter gas onto the surface of the silicon substrate.

(57) 要約: ゲート絶縁膜として所望の特性を有する $\text{Hf}_{1-x}\text{Al}_x$ ($0 < x < 0.3$) の酸化膜を形成することのできる半導体装置の製造方法を提供する。

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WO 2004/084291 A1

明細書

半導体装置と半導体装置の製造方法

技術分野

本発明は、半導体装置と半導体装置の製造方法に関し、特に高誘電率の絶縁膜を有する半導体装置と半導体装置の製造方法に関する。

背景技術

半導体集積回路装置に用いられる代表的半導体素子として、MOSトランジスタを代表とする絶縁ゲート（IG）型電界効果トランジスタ（FET）が広く用いられている。半導体集積回路装置の高集積化のために、IG-FETはスケリング則に従って微細化されてきた。微細化は、ゲート絶縁膜を薄くする、ゲート長を短くする、等IG-FETの各寸法を縮小し、微細化した素子の性能を正常に保ち、性能を向上することを可能とする。

MOSトランジスタは、ゲート酸化膜の上にシリコン製ゲート電極を有する。シリコンゲート電極は、n型不純物である燐（P）や砒素（As）、またはp型不純物であるボロン（B）をドーピングされる。ゲート酸化膜が薄くなると、ゲート電極の不純物がゲート酸化膜を突き抜け、下方のチャネル領域に拡散する現象が生じる。ゲート電極の不純物がチャネル領域に拡散すると、トランジスタの閾値を低下させ、パンチスルーを生じさせる。特にpチャネルトランジスタにおけるボロンの突き抜けが問題となる。

ゲート酸化膜に窒素を導入するとボロンの突き抜け防止に有効であることが知られている。例えば、ゲート酸化膜を熱酸化で形成した後、熱窒化を行うことにより、ゲート酸化膜に窒素を導入できる。

次世代のMOSトランジスタのゲート酸化膜の厚さは2 nm以下に薄膜化することが要求される。この膜厚はトンネル電流が流れ始める厚さであり、ゲートリーク電流が制御できなくなり、消費電力の増大を回避できなくなる。ゲート絶縁膜として酸化シリコンを用いる限り微細化に限界が生じる。ゲート絶縁膜を貫通するトンネル電流を抑制するためには、厚いゲート絶縁膜を用いればよい。